



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

GEOLOGICAL SURVEYS IN MISSOURI.

THE first geological survey of Missouri, having for its field of operations the whole state, exclusively, was provided for by an act of legislature just fifty-one years ago. A period of partial surveys by state and national governments had immediately preceded this, and a period of exploration and travel, and of primitive mining, was of still earlier date.

The explorations of Joliet, of La Salle, and of Hennepin, in the last quarter of the seventeenth century, had transformed the Mississippi valley from *terra incognita* to a promising field for adventure or profit, and, with the establishing of a settlement at the mouth of the Mississippi by Le Moyne d'Iberville in 1699, excursions up the river became frequent. In Le Sueur's expedition, in 1700, the existence of Missouri lead ores became known. This served, a few years later, as one of the incentives leading to the settling of the country by the Company of the West under the Crozat patent. From this time to the end of the eighteenth century the lead deposits were almost continuously worked, sometimes on a large scale, but no record of any careful investigation has come down to us from these early days.

With the beginning of the present century and the transfer of the territory to the United States, an era of somewhat closer observation seems to have been inaugurated. Among the earliest papers touching the geology of Missouri is Austin's "Descriptions of the Lead Mines in Upper Louisiana," written in 1804, covering a few pages of the American State Papers.¹ This is almost entirely descriptive of the lead mines of southeastern Missouri, and treats principally of their superficial features and conditions of development. During the next thirty years, a

¹ Public Lands, Vol. I., p. 188. Reprint Report Mo. Geol. Surv. 1873-74, p. 686.

number of similar short, descriptive reports appeared in these volumes.¹

Between the years 1804 and 1807 the Lewis and Clarke² and the Pike³ expeditions were conducted for the United States government. These expeditions added much to our knowledge of the geography⁴ of the country traversed, but their geological results were meagre, and limited to a strip of country adjacent to the lines of travel.

The year 1815 is worthy of note as marking the beginning of the Land Office surveys in the state. These surveys continued until 1850, and supplied an admirable basis for future areal work in geology. Of interest in this connection is the fact that, during the first two or three decades of operations, the surveyors were required to report to the Land Office, along with their other field notes, the presence or absence of mineral on the land traversed. Drusy quartz, known as "mineral blossom," and other superficial phenomena of wide occurrence, were used as criteria, and, as these notes formed the basis for local classification, complaints soon became loud that so much land was being withdrawn from occupation on account of its being classed as "mineral land," that the settling of the country was seriously interfered with. This led eventually to the abandoning of the early, crude attempt at accomplishing some of the objects of a geological survey.

Schoolcraft's well known tours throughout the western country were made between the years 1816 and 1819, and the three volumes⁵ of his observations contain much excellent statistical

¹ For specific references see Bull. No. 2, Geol. Surv. of Mo., 1890, Bibliography pp. 46 and 48.

² Travels to the Source of the Missouri River. By Capts. Lewis and Clarke, 1809 and 1814.

³ Expeditions to the Sources of the Mississippi, etc. By Maj. Z. M. Pike, 1810 and 1811.

⁴ Reference to the geographical results of this and other early explorations and surveys will be found in a paper by the writer entitled, "The Mapping of Missouri," Trans. Acad. Science of St. Louis, No. 8, Vol. VI., 1893.

⁵ Views of the Lead Mines of Missouri, etc., 1819.

Journal of a Tour into the Interior of Missouri and Arkansas, etc., 1821.

Scenes and Adventures in the Semi-Alpine Region of the Ozark Mts., etc., 1853.

and descriptive matter relating to Missouri, and especially to the mines and topography.

The Long expedition of 1819,¹ similar in nature to the Lewis and Clarke and the Pike expeditions, was equally poor in geological results.

In the year 1821, Thomas Nuttall, the botanist, recorded certain observations on the "Geological Structure of the Valley of the Mississippi"² in which he alludes to the limestones of the valley and correlates them with Martin's *Petrifacta Derbiensis*. This, as Professor H. S. Williams has already pointed out,³ is probably the first recognition of "Carboniferous rocks" in the region. Soon after this, in 1822, Dr. Edwin James called attention to the existence of a sandstone in the Ozark mountains of southeastern Missouri, with a clay slate, like the primitive slate of New England, intervening between it and the granite.⁴ This was the first suggestion of the presence of Cambrian or Lower Silurian rocks in Missouri.

During the next ten and more years much attention was attracted to Missouri and other Mississippi valley states, through the extension of mining operations, especially in Iowa and Wisconsin. In volume 12 of the *American Journal of Science*, 1827, there are a number of references to mines and descriptions of minerals found.

During the years 1834 and 1835, G. W. Featherstonehaugh made his well known trip through Missouri and other western states.⁵ In his reports he frequently refers to the limestones along the Mississippi as of Carboniferous age, and to the abundance of fossils in the exposures between St. Louis and Herculaneum, some of which he has found identical with European

¹ Account of an Expedition from Pittsburgh to the Rocky Mts., etc., 1823.

² Jour. Acad. Sci., Philadelphia, 1821, Vol. 2.

³ Bull. No. 80, U. S. Geol. Surv., pp. 25 and 137.

⁴ Jour. Acad. Sci., Philadelphia, 1822, Vol. 2.

Also: C. D. Walcott, Bull. 81, U. S. Geol. Surv.

⁵ Geol. Report of the Elevated Country between the Missouri and Red Rivers, 1835.

Reconnaissance to the Green Bay and the Wisconsin Territory, 1836.

forms. From this and other statements it is plain that he did not discriminate between the different limestone formations which we now recognize in the Mississippi valley. He made a special examination of southeastern Missouri, and expresses the conclusion that the disseminated lead ore of Mine la Motte must necessarily have been deposited at the same time as the limestone; also that the veins of this country undoubtedly descend very deep towards the central part of the earth; and, finally, that the ore in these veins was "projected from below," the lateral veins from a main lode being compared to the branches of trap dikes, while the red clay is paralleled by the red mud accompanying volcanic eruptions in Sicily. The iron ores of Missouri, he also states, are of direct subterranean origin and fill veins or fissures produced by dislocation.

Though such ideas seem extravagant to us now, they were discussed and believed by scientific men of the day. Thus, in the proceedings of the fifth session of the American Association of Geologists and Naturalists, after a statement of Professor J. Locke's, that the Trenton age of the rocks containing lead ores of the upper Mississippi had been determined, Dr. Houghton replied that he did not think the ores were confined to any special limestone, but that they had been sublimed and segregated through the heat of intrusive trap. R. E. Rogers expressed himself in support of a similar explanation. In answer to this Dr. H. King sagaciously remarked that no volcanic or igneous action had taken place in Missouri or elsewhere in this lead region, and thus could not have influenced the segregation of the lead; that the subjacent rocks were not traversed by dikes, and that the lead ore was imbedded in the rock, like masses of chert.¹ Again Mr. J. T. Hodge, in 1842, in a long article on the Missouri and Wisconsin-Iowa mining regions, after describing copper deposits of Missouri, concludes that the copper ore had apparently been projected from below, either melted by sublimation or by slower electrical causes.²

¹ See *Am. Jour. Sci.*, Series I., Vol. 47, 1844, p. 106.

² *Am. Jour. Sci.*, Series I., Vol. 43, 1842, p. 69.

The year 1840 brings us to the date of publication of Owen's report on the Mineral Lands of the United States in portions of Iowa, Wisconsin and Missouri,¹ following closely upon his report as state geologist of Indiana upon work of 1838 and 1839. In 1844, a second and revised edition of his Mineral Lands report was issued, and, in 1852, his final report on Wisconsin, Iowa, and Minnesota appeared. These reports supplied the guiding lines along which later stratigraphic work in the Mississippi valley was done. Without attempting here to present the history of this work,² its bearing upon the future work in Missouri calls for brief mention. In the Indiana reports Owen makes a separation of the rocks, in harmony with the English classification, into: (1) Bituminous Coal formation; (2) Mountain limestone; (3) Grauwacke; (4) Crystalline and inferior stratified rocks. In the succeeding reports, as the results of wider observation and more thorough study, the classification was changed and differentiated until, in the final report, we find a classification which, not only in its general features, but in many of its details, is still adhered to in Missouri. The map accompanying this report attempts a representation of the areal geology of the northern half of the state. On this map the western margin, as far east as Wellington, is colored as belonging to the Upper Series of the Carboniferous limestone; along the Mississippi river a similar belt of both the Upper and Lower Series is represented; while, along the Missouri river, from above Jefferson City to Tower Rock, is an area of Lower Magnesian limestone. Between these a broad stretch of Coal Measures is shown.

The explorations and surveys thus far referred to were the results of private enterprise or were made under the auspices of the national government. The earliest record we have of action on the part of the state is in the message of Governor Lilburn W. Boggs in 1833. He there recommends an appropriation for

¹ House Exec. Doc., No. 239, 26th Congress, 1st Session.

² For summary concerning the Devonian and Carboniferous, see H. S. Williams, Bull. 80, U. S. Geol. Surv., p. 137 *et seq.*

a geological survey as an adjunct to a general system of internal improvement. Shortly after this a Board of Internal Improvements was formed, and, among other works, surveys of the Meramec, of the Salt, of the North Grande and of the Osage rivers were started. In connection with this, a geological examination by Dr. Henry King was made along the Osage river, and a report of twenty pages was published in 1840.¹

Much of this report is devoted to the topography and soils, and to a description of occurrences of ore. Dr. King assigns all of the rocks of the region to the Carboniferous formation and separates them into two series: (1) A lower Galeniferous or Lead series; (2) an upper Coal series. By the former he plainly means the magnesian limestones and associated sandstones, though the section given is very imperfect; in the latter he includes the Encrinital or Lower Carboniferous limestones as well as the overlying coal beds, sandstones, and shales. The change between the two series is so marked, however, that he expresses the feeling that an entire separation of the two is almost justifiable. The lead ores of the region he assigns to the uppermost member of the lower series; the surface float ore, or "patch mineral," as he calls it, he determines correctly to be residuary from the decay of the limestone.

After this, further investigations by the state seem to have fallen into neglect for several years; but, by 1846, the subject again excited public attention and the question of a geological survey called forth a number of memorials from conventions, and of papers prepared by scientific associations, and was further recommended in the messages of several governors. Finally, by an act approved February 24, 1853, the First geological survey of Missouri was authorized.² The act controlling the First geological survey provided for the appointing by the governor

¹ Senate Journal, Appendix, 1st Session, 11th Gen. Assembly, 1840, pp. 506-525.

² Additional information beyond what is given in the following pages, relating especially to the laws governing the various state surveys, their organization, and plans of work, will be found in an historical sketch of Missouri Geological Surveys, forming part of the writer's Biennial Report to the 36th General Assembly, House Journal, 1891.

of a state geologist, who, in turn, was allowed the appointing of not more than four assistants, who were to be skilful chemists, and of such other subordinate assistants as he might deem necessary. The work of the survey was to include stratigraphic and structural geology and special studies of economic geology. Annual reports were required, and a final report, or a complete memoir on the geology of the state, was to be prepared on the completion of the survey. Specimens in triplicate were to be collected and forwarded to the Secretary of State; one set for a cabinet in the state capitol, another for the state university, and the last for the city of St. Louis. Ten thousand dollars annually for a term of two years were appropriated.

Pursuant to the instructions of this law, Professor G. C. Swallow was appointed state geologist by the governor in 1853. Professor Swallow came directly from Maine, where he had been engaged in teaching. The survey continued in active operation until, June 1861, under the direction of Professor Swallow. The controlling plan of the work as laid down by him, in the letter of transmittal accompanying his second annual report, was to prepare: "First, an outline of the geology of the state; second, a general view of the mineral wealth of the mining districts; third, an exposition of the agricultural and manufacturing resources of the state; fourth, reports in detail upon as many counties as possible."

Five reports were published by this survey, but the second, of 447 pages (with which is printed the first, of but four pages) is the only one which embodies the results of field work, and this is the one generally known as the Swallow report. The others are very brief reports of administration and progress. Part I of this Second Annual Report contains chapters by Professor Swallow on the general geology of the state and two county reports; Part II contains a chapter by Dr. Litton on the lead mines of southeastern Missouri, and three county reports by Meek and Shumard, as well as several general cross sections and a short paper on paleontology.

After the issue of this report the survey continued in active

operation until 1861, during which time its labors seemed to have been centered upon systematic county work, leading to the production of special county maps and reports. A table contained in the fifth report of progress shows that, up to the end of 1860, field work had been completed in eighty counties, and of these, reports had been made upon thirty-three; in a considerable number of other counties more or less work had been done. Five of these reports were contained in the Second Annual, and twenty more constitute a report issued in 1873; others were probably used in the preparation of the county descriptions of the other reports of 1873 to 1874. In addition to this work, during the period of the first survey, Professor Swallow made an official report of ninety-three pages on the Southwest Branch of the Pacific Railway.

Reviewing, briefly, this work of the First geological survey, we must recognize as remarkable and excellent the classification of the rocks which are evolved, as well as the general accuracy with which the distribution of the formations was defined, especially when the short time is considered; avowedly under the control of Hall's New York classification and nomenclature, published in 1843, though undoubtedly assisted, yet not misled by Owen's results, Swallow and his assistants established a table of formations, and outlined a geographical map of the state which remains to this day unchanged in its larger features.

From 1860 to 1870, geological work was nearly at a standstill in the state. During this period, however, Professor Swallow, as professor of geology at the state university, and various of his assistants in different capacities, extended their observations in the state, and published the results in scientific journals or in the proceedings of scientific societies.¹

In March, 1870, an act was passed authorizing the Second geological survey. The provisions of this act were in the main similar to those of the first, with the exception that the Bureau was placed under the control of a board of managers of nine

¹ For a Bibliography of the Geology of Missouri, see Bull. No. 2, Mo. Geol. Survey, 1890.

members. The state geologist was allowed to appoint one assistant state geologist, who was required to be a chemist, at an annual salary of \$2,000; also other subordinate assistants at not more than \$1.50 per day. Provision for the appointment by the Board of a state assayer was also made. For the "general expenses" of the bureau the sum of \$7,500 was allowed annually. Under this law Albert D. Hager, previously of the Vermont survey, was appointed state geologist. The law was amended in March, 1871. The number of the members of the Board was reduced to four, and the allowance for the annual expenses raised to \$10,000. Mr. Hager held this position until August, 1871, and published one report of progress, twenty-one pages in length, in which he briefly notices the chief building stones and minerals of the state. After Mr. Hager's resignation, Dr. J. C. Norwood was in temporary charge. In November, 1871, Mr. Raphael Pumpelly was appointed state geologist. He resigned from the position in May, 1873.

Up to the time of Mr. Pumpelly's appointment, very little had been made public of the results of the surveys, and the changes of management must necessarily have retarded and weakened the work. Notwithstanding this, however, Governor B. Gratz Brown, in his message of December, 1871, commends the survey warmly to the Legislature, and, as a result, the law was amended in the following March, and the sum of \$20,000 was appropriated annually for the salaries and expenses of the Bureau.

Two classes of work were provided for in the Pumpelly survey, *i. e.*, (1) the study of the stratigraphy of the state; (2) the study of the mineral deposits. The stratigraphic work was divided into five departments covering different sections of the state; that of economic geology was divided into three, including a department of iron ores and metallurgy, a department of ores other than iron, and a department of fuels and materials of construction other than iron and wood. Under the Pumpelly management two reports were issued in 1873. The first was an octavo of 323 pages, already referred to as containing twenty

county reports, prepared during the Swallow survey.¹ The second volume was a large octavo of 655 pages² transmitted in April, 1873. Part I consists, first, of a chapter on the geology of Pilot Knob and vicinity by Mr. Pumpelly; the second chapter embodies analyses of ores, fuels and pig irons; chapters III to IV, inclusive, constitute a partial report on the iron ores of Missouri by Dr. Adolph Schmidt. Part II consists of fifteen chapters and three appendices; of these, chapters I to VI contain general information relating to the coal fields of the state by Prof. G. C. Broadhead; chapters VII to VIII are on the geology of Lincoln county by Prof. W. B. Potter; chapters IX to XV consist of reports on seven counties by G. C. Broadhead; appendices A, B and C relate to building stones and contain a list of Coal Measure fossils.

After Mr. Pumpelly's resignation, Prof. G. C. Broadhead was appointed state geologist and assumed charge in July, 1873. During this administration the examinations of the iron ores and of the lead and zinc deposits were continued, and surveys for a number of county reports were made. One volume was issued by the Broadhead survey.³ This is a large octavo of over 790 pages transmitted in August, 1874. Chapters I to VI, inclusive, are upon general topics relating to the history of exploration and the general geology of the state by Professor Broadhead; chapters VI to XXI, inclusive, consist of reports on fifteen counties; chapters XXII to XXXII, inclusive, and XXXIV, describe the lead and zinc deposits of the state from work done by Dr. Schmidt and Mr. A. Leonhard; chapters XXXIII and XXXV relate to the iron ores of southeastern

¹ Reports on the Geological Survey of the State of Missouri, 1855-1871, by G. C. Broadhead, F. B. Meek and B. F. Shumard, Jefferson City, 1873, pp. 324 and iv.

² Geological Survey of Missouri, Raphael Pumpelly, Director. Preliminary Report on the Iron Ores and Coal Fields, from the field work of 1872, with 190 illustrations in the text and an atlas. New York: Julius Bien, 1873. P. xvi., 214 and 441.

³ Report of the Geological Survey of Missouri, including field work of 1873-74, with 91 illustrations and an atlas. Garland C. Broadhead, State Geologist, Jefferson City, 1874. Pp. 734, L. 4, 50.

Missouri. Appendices A, B, C and D contain much statistical and other matter of subordinate interest.

The survey was discontinued after the year 1874, and most of its working material was transferred to the state School of Mines at Rolla, of which the president, Dr. Charles P. Williams, was made acting state geologist, with a nominal appropriation. Little field work seems to have been carried on under Dr. Williams, and, after the year 1876, no further support was extended to the work by the state. One report was prepared by Dr. Williams, which consists of a small octavo of 117 pages. It contains a chapter on the "Mineralogy and General Metallurgy of Lead," one on the "Zinc Industry of Missouri," one on the "Iron Industry," and one on "Shannon County"; in the appendices are given a few statistics of lead and zinc, and a "Note on the Occurrence of Gold in Northwestern Missouri."

Reviewing the results of the Second geological survey, its contribution to our knowledge of the geology of the state consisted principally: (1) of Pumpelly's observations, too soon interrupted, upon the crystalline rocks, whose work threw much new light upon their nature and relations, though the report has left us in some doubt as to whether he considered the whole mass of the porphyries metamorphosed clastics, or whether he meant this to apply only to the Pilot Knob beds; (2) of Broadhead's detailed stratigraphic results in the Coal Measures which placed on record many new and valuable sections, added much concerning their correlation, and demonstrated the thickness of this formation to be much greater than had been formerly believed; (3) of Schmidt's report on the iron ores and lead and zinc deposits, especially strong in its treatment of the mineralogy, but deficient in its interpretations of structure, and lacking in suggestions as to origin and processes. The classification of the clastic rocks remained substantially the same as tabulated by Swallow and Shumard, the principal changes displayed in the chart opposite page 18 of the report of 1873-74 being in the subdivisions of the Lower Carboniferous; in the transference of the Chouteau, Vermicular and Lithographic stages to this series; and

in the assignment of the Third Magnesian limestone and all below it to the Potsdam period.

Summarizing the products of both the First and Second surveys, we find that there were published six volumes, varying in length from ninety-three to over 700 pages, and four pamphlets, aggregating about fifty pages. The appropriations for these two geological surveys, as given by Broadhead.¹ are as follows:

	APPROPRIATIONS.	EXPENDITURES FOR PRINTING.
From 1853 to 1862 - - -	\$105,000	\$5,000
1870 and 1871 - - -	12,500	
Under acts of 1872, 1873 and 1874	60,000	19,320
In 1876 and 1877, and by School of Mines - - - -	5,000	1,500
Printing, 1873 - - - -	12,000	
Printing, 1876 - - - -	1,500	
Total - - - -	\$196,000	\$25,820
Unexpended appropriations -	19,814 ²	
Total expended - - -		\$176,185
Balance for salaries and current ex- penses - - - -		150,365

After the stoppage of the apology for a geological survey, for which provision was made under Professor Williams' control, no public geological work was conducted until the year 1884, when topographic work was begun in the state by the United States geological survey. This was continued until July, 1889, up to which time about one-third of the state was mapped on sheets of a scale of two miles to the inch, and with contour intervals of fifty feet. In addition Mr. W J McGee was detailed in 1887, by the national survey, to make a brief study of the geology of a portion of Macon county, the results of

¹ Missouri Geological Surveys. Historical Memoir. Trans. Acad. Sci. of St. Louis. Vol. IV. Pp. 611-614.

² We are informed by Professor Broadhead that the larger part of this unexpended appropriation belonged to the period of the Swallow Survey, though part of it also reverted during the Hager administration of 1870 to 1871.

which are published in Vol. V. of the Transactions of the St. Louis Academy of Science.

In May, 1889, the act authorizing the present, or Third geological survey, was approved. It was evidently framed upon the laws of the preceding surveys, though it differed from them in detail. The most noticeable differences are the absence of a requirement to collect specimens in triplicate, and the absence of a clause requiring county maps and reports to be prepared. The state geologist is, however, directed to have complete and detailed maps and reports of counties or districts prepared. The appropriation for the two years, 1889 and 1890, was \$20,000; that for 1891 and 1892 was \$40,000; out of this all salaries and expenses were to be paid, including cost of publication. For the years 1893 and 1894, \$20,000 have been appropriated, though the paper for publications is furnished in addition.

The writer was elected state geologist in August, 1889, and entered upon the discharge of his duties the end of September following. The plan of work adopted for this survey was: (1) to prepare a series of monographic reports upon separate subjects, which may be called Subject reports, applying to the whole state; those subjects of direct economic importance to receive first consideration; (2) to prepare successively a series of detailed maps of different portions of the state, and to accompany these with special reports containing much descriptive detail, which we may call Area or Sheet reports.

The subjects of work so far undertaken have been: the lead and zinc deposits; the coals and the Coal Measures; the clays; the iron ores; the mineral waters; the building stones; the crystalline rocks; the Quaternary, or, more exactly, the glacial geology; the paleontology; the hypsometry; general geologic mapping. Work has advanced on all of these subjects to varying extents. The study of the lead and zinc deposits was begun in coöperation with the national geological survey, but has been carried to completion by the state survey, and the report is now nearly finished. A Preliminary Report of 226

pages on the Coals of the state, by the writer, has been issued, but a great bulk of additional information has been gathered for a final report. The field work for the report on Clays was finished last year, and the report, by Prof. H. A. Wheeler, is now well advanced. A report on the Iron Ores of 391 pages, by Frank L. Nason, was published in 1892, together with one of 280 pages on the Mineral Waters, by Paul Schweitzer. The building stones were studied first by G. E. Ladd and later by Hiram Philips, but the field work is not yet completed, and had to be suspended this year. The crystalline rocks were studied by Erasmus Haworth and the report is written, but is withheld from publication for lack of funds. Field work for a preliminary report on the glacial geology, by J. E. Todd, was completed last year, and the report will soon be ready for transmission. An exhaustive review of the paleontology of the state by Charles R. Keyes is ready for publication. All available data relating to the hypsometry of the state have been collected and tabulated, and a few months additional work will put them in shape for publication. Along with the prosecution of work on these general subjects, many additional facts for more exact and detailed geological mapping have been collected; but in addition to this, mapping of the formations has been specially done over certain important areas of the southwestern and northeastern portions of the state.

For the Area or Sheet reports, fifteen sheets have been prepared, distributed over the central portion of the state along the margin of the Coal Measures, over the southwestern lead and zinc district, and over the southeastern lead district and Archean area. These sheets are on a scale of one mile to the inch with a twenty-foot contour interval, and cover each a quadrilateral of fifteen minutes of latitude and longitude. They include, in addition to the topography and general geology, much detail of special economic importance. Three of these sheets have been engraved, and the accompanying reports printed. The others are about ready for the engraver, and the reports are partly prepared.

Summarizing the official publications of the Third survey to date they are as follows:

Reports published:

Vol. I. A Preliminary Report on Coal, 8vo, 226 pages; Vol. II. Report on Iron Ores, 8vo, 391 pages; Vol. III. Report on Mineral Waters, 8vo, 280 pages; Five Bulletins, including a Bibliography of the Geology of Missouri, and articles on the coals, building stones and clays, mineral waters, crystalline rocks, and paleontology, aggregating 470 octavo pages. Also two administrative Biennial Reports aggregating 90 pages.

Three sheets and accompanying reports as follows: No. I. Higginsville Sheet and large folio report, 18 pages; No. II. Bevier Sheet and octavo report, 90 pages; No. III. Iron Mountain Sheet and octavo report, 96 pages.

Reports completed but not published:

Report on Paleontology, 400 8vo pages (estimated); Report on the Crystalline Rocks, 300 pages (estimated).

Reports nearly completed:

Report on Lead and Zinc Deposits, 500 8vo pages (estimated); Report on Clays, 400 8vo pages (estimated); Report on Quaternary Geology, 150 8vo pages (estimated); Report on Hypsometry, 150 8vo pages (estimated).

Reports only partly prepared:

Final Report on the Coal Measures; reports on twelve sheets of detailed mapping.

ARTHUR WINSLOW.